TO DETERMINE THE FRACTURE AND ACCURACY BY USING TUNING FORK DIRECT TEST AND AUSCULTORY TUNING FORK TEST AMONG PATIENTS WITH STRESS FRACTURE

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ABSTRACT

Stress fractures results in micro trauma to the bone caused by repeated mechanical stress injuries. Stress fractures are common injuries in sports people the result of normal healthy bone being subjected to repetitive loading forces, while training. Normally asses clinically, physical exams like tenderness to palpation, focal temperature increases and pain with various tests like fulcrum, and a hop test. Radiographic confirmation of stress fractures includes X-ray, bone scintigraphy scan, CT, and MRI. However, MRI is expensive and may not be available in all hospitals and difficult to get the immediate appointments. The vibration of a tuning fork has been recommended as a way to locate and diagnose a stress fracture by inducing vibratory pain at the site of the injury. Many clinicians and sports physiotherapist were using tuning fork for initial diagnosis of fracture and stress injuries. The aim of this was to identify the correct techniques used for confirmation diagnosis of fractures using a tuning fork directly apply tests and stethoscope technique for the presence of fracture. Patients were selected all those diagnosed hairlines by X ray with stress fracture of the lower extremity bones who consented to participation. Once identified, eligible participants received a standard history and physical exam including palpation for tenderness and participants were asked to their pain. The fracture site was located from x ray and marked by an "x" on the skin. Two tests were followed by the researcher. The author Struck the 128 Hz tuning fork against the rubber pad and then placed the vibrating tuning fork was applied with sufficient pressure to leave an indentation on the skin at the point of maximal tenderness. After placing the tuning fork on the point of maximal tenderness, the tuning fork was moved proximal and distal 2 cm in each direction to see if this also elicited tenderness. The second test was performed on the uninjured limb first. Struck the tuning fork against the rubber pad and then placed the vibrating tuning fork on the bone distal to the marked fracture site ("X"), and the stethoscope's conical bell was placed proximal to the injury site on the same bone. Then listened to the sound arising from the bone via the stethoscope for approximately 5 to 10 seconds. And listened for a clear tone created by the tuning fork in the uninjured bone and compared it with the sound arising from the injured bone. From this study turning fork directly applied fracture site the sensitivity and accuracy was 100% but measuring tuning fork with stethoscope method the sensitivity and accuracy was 75%. From these results tuning fork with stethoscope method may not reliable for measuring hairline fracture. Analysis suggests that, for stress fracture injuries, the tuning fork with stethoscope test is less reliable comparatively pain sensation of tuning fork test. From these studies tuning fork with pain sensation 100% of sensitivity but tuning fork with stethoscope sound deflection the sensitivity was 75%. From this study tuning fork with pain sensation is more accuracy.

Key Words: Stress fracture, tuning fork test, pain.

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INTRODUCTION

Stress fractures result microtrauma to the bone caused by repeated mechanical stress injuries[1]. Stress fractures are common injuries in sports people the result of normal healthy bone being subjected to repetitive loading forces[1], while training. The tibia is the most common site for stress fractures in sports peoples[2].Normally asses clinically physical exams like tenderness to palpation, focal temperature increases and pain with various tests like fulcrum, and a hop test[3]. Clinically radiographic confirmation of stress fractures includes X-ray, bone scintigraphy scan, CT, and MRI. However, MRI is expensive and may not be available in the all the hospitals and difficult to get the immediate appointments.

Widely the tuning fork has been used to detect hearing loss and vibratory sensation defects. J G Finkenberg in his study, he used an electrical vibration apparatus on patients with a clinical diagnosis of occult fracture of the scaphoid.

Since 1983, when first included in a textbook on sports medicine, the vibration of a tuning fork has been recommended as a way to locate and diagnose a stress fracture by inducing vibratory pain at the site of the injury[4]. The first attempt to evaluate the accuracy of the tuning fork was by Lesho in 1997. The results' evaluation reported sensitivity and specificity of 75% and 67%, respectively[5]. Many clinicians and sports physiotherapist were using tuning fork for initial diagnosis of fracture and stress injuries.

Currently two methods of using tuning forks to detect fracture(s) have been developed. The first method uses a vibrating tuning fork placed directly over, or closely proximal to the suspected fracture site. Because the periosteum is heavily innervated, mechanical vibration over a fracture site stimulates the overlying periosteum, causing pain[6]. The second method uses a vibrating tuning fork placed over a bony prominence distal to the fracture site. Using a stethoscope to listen to the sound over a bony prominence proximal to the fracture site, the fracture is detected by a reduction in the sound conducted along the bone compared to the unaffected limb[7].

Misurya et al. Used a child stethoscope and a 128 Hz tuning fork to detect fractures of the neck of the femur, the shaft of the femur, and the tibia in 50 patients. He compared clinical diagnosis and the auscultatory tuning fork test against the gold standard of x-ray examination. From his study Forty-seven patients were correctly detected by the Barford test (94% sensitivity) versus 44 patients[10] (88% sensitivity).

Also Fredericson M et al The tuning fork test entered the sports medicine literature as an office test that might be useful in diagnosing stress fracture in 1983 Without detailed validation studies, the test was subsequently cited as potentially valuable in sports medicine training in 1987, 1993, and 1995[11]. Wilder et al. Compared three vibration frequencies (128, 256, and 512 Hz) of tuning forks with available imaging studies on 45 runners with suspected stress fractures. Fracture locations ranged from tibial to navicular, metatarsal, calcaneus, fibula, phalanx, talus, and tarsal bones. Wilder's team found that the mid-frequency (256 Hz) instrument elicited the highest pain ratings; they calculated sensitivity for detecting a stress fracture as ranging from 77.7% to 92.3% with this instrument. In contrast, the specificity of the 256-Hz tuning fork was only 20%, consistent with many false-positive results[13].

Michael Bryan Moore, PhD Among the 37 patients examined, radiographs confirmed the tuning fork assessment of fracture in 10; 20 true negative results were also confirmed. False-positive results occurred in 5 patients and false-negative results. The tuning fork evaluation method was highly successful in detecting transverse fractures (n = 10) but not avulsion (n = 1) or buckle (n = 1) fractures. The 2 false-negative results occurred in patients with the avulsion and buckle fractures[14]

The **AIM** of this was to identify the correct techniques used to confirm the diagnosis of fractures using a tuning fork directly apply tests and stethoscope technique for the presence of fracture.

MATERIALS AND METHOD

The inclusion criteria for the review were primary studies that assessed the diagnostic accuracy of tuning forks, using either pain or reduction of sound as the index test, measured against a recognized X-ray diagnosis of fractures.

This evaluation included those who diagnosed as hairline fracture by X ray and entered orthopedic clinic , ER department in khorfakkan hospital. Inclusion criteria included all those diagnosed hairlines by X ray with stress fracture of the lower extremity bones who consented to participation. Once identified, eligible participants received a standard history and physical exam including palpation for tenderness and participants were asked to their pain. Physical exams were performed by physiotherapist working in the khorfakkan hospital. The fracture site was located from x ray and marked by an "x" on the skin.

METHOD

Procedure 1

The author Struck the 128 Hz tuning fork against the rubber pad and then placed the vibrating tuning fork was applied with sufficient pressure to leave an indentation on the skin at the point of maximal tenderness. After

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placing the tuning fork on the point of maximal tenderness, the tuning fork was moved proximal and distal 2 cm in each direction to see if this also elicited tenderness. The tuning fork was struck on a firm surface every 5-10 s to maintain maximal vibration.

If no pain with the tuning fork was elicited, the result was recorded as a negative tuning fork test.

Procedure 2

The author administered test was performed on the uninjured limb first. Struck the tuning fork against the rubber pad and then placed the vibrating tuning fork on the bone distal to the marked fracture site ("X"), and the stethoscope's conical bell was placed proximal to the injury site on the same bone. Then listened to the sound arising from the bone via the stethoscope for approximately 5 to 10 seconds and also listened for a clear tone created by the tuning fork in the uninjured bone and compared it with the sound arising from the injured bone. If no sound or interrupted sound, the result was recorded as a positive tuning fork test. If clear sound the result was negative

Sensitivity was defined as [true-positives]/ [true-positives + false-negatives]. Specificity was defined as [true-negatives]/[false-positives + true negatives]. Positive predictive value was defined as [true-positives]/[true-positives + false-positives].

Negative predictive value was defined as [true-negatives]/[false-negatives + true negatives

RESULT

A total of 102 confirmed hairline fracture diagnosed by X Ray. Of 102 patients among 97 males and 5 females the average age was 30.

Table 1

TUNNING FORK WITH STETHOSCOPE TEST

Total number of patients	Total number of positive	Total number of negative	sensitivity	Accuracy
102	77	25	75	75

From this study 102 fractures ***(Table1)*** were recognized by x ray, of these 77 of them were identified by TF with stethoscope test so the Sensitivity 75%. In 25 subjects a fracture was negative but X ray was positive so false negative was 25. False positive and true negative was 0 so the Specificity 0%. The accuracy Value was 75%.

Table 2 TUNING FORK IN FRACTURE SITE TEST

Total number of patients	Total number of positive	Total number of negative	sensitivity	Accuracy
102	102	0	100%	100%

Of these 102-fracture (***Table 2***) diagnosed by X Ray all the patients got pain sensation from tuning fork directly applied the fracture site. So the sensitivity was 100% and accuracy was 100%.

DISCUSSION

From this study turning fork directly applied on fracture site, the sensitivity and accuracy was 100% but measuring tuning fork with stethoscope method the sensitivity and accuracy was 75%. From these results tuning fork with stethoscope method may not be reliable for measuring hairline fracture. Also previous researchers did not address that tuning fork test is 100% sensitivity of hairline fracture.

But Wilder and his team found that the mid-frequency (256 Hz) instrument elicited the highest pain ratings; they calculated sensitivity for detecting a stress fracture as ranging from 77.7% to 92.3% with this instrument.

Comparatively Lesho's study reported evaluate the accuracy of the tuning fork using bone scan as the gold standard and without regard to stress fracture location along the tibia. He reported sensitivity and specificity of 75% and 67%, respectively. However, Lesho concluded that the TF test was not sensitive enough to rule out stress fractures on basis of negative test. Kayalvili Mugunthan study shows that the diagnostic accuracy of TF test was included six studies (329 patients with 7-60 years age), with two types of tests (pain induction and loss of sound transmission). The prevalence of fracture ranged from 10% to 80%. The sensitivity of the TF tests was high, ranging from 75% to 100% and, the specificity highly heterogeneous, ranging from 18% to 95%. They concluded that TF tests have value in ruling out fractures, but are not sufficiently reliable for widespread clinical use.

Misurya et al used a child stethoscope and a 128 Hz tuning fork to detected 94% sensitivity.

This study found 128 Hz frequency tuning fork 100% sensitivity and tuning fork with stethoscope method sensitivity 75% in those diagnosed by X ray.

Most of the studies the tuning fork evaluation method was highly successful on transverse fractures. In a transverse fracture, space created by the fracture is sufficient to decrease the sound of tuning fork and, thus, the sound is diminished. Avulsion and buckle fracture the bone injured but intact and, therefore, sound is not

commonly affected. Misurya et al and Bache and Cross explained that sound waves from the tuning fork are transmitted easily in non-transverse fractures because enough of the bone remains in contact.

The only false-negative results that were identified occurred in patients with avulsion and buckle fractures.

CONCLUSION

Analysis suggests that, for stress fracture injuries, the tuning fork with stethoscope test is less reliable comparatively pain sensation of tuning fork test. From these studies tuning fork with pain sensation 100% of sensitivity but tuning fork with stethoscope sound deflection the sensitivity was 75%. This study draws that tuning fork with pain sensation is more accurate.

Also suggest that tuning fork assessment improves the specificity of fracture assessment in the absence of radiographs. The tuning fork test is an acceptable method for identifying fractures when radiography is not immediately available. The test is easy, painless, and inexpensive to perform, and it can be administered quickly. It can be a useful tool for field evaluations.

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